

## WHAT IS CLAIMED IS:

1. A high pressure piston pump, comprising:  
a housing having a low pressure fuel inlet and a high pressure fuel outlet;  
at least two pistons disposed in the housing;  
a driveshaft for supplying power to drive the at least two pistons; and  
a bypass valve fluidly connected to at least one of the at least two pistons to deactivate the at least one piston.
2. The high pressure piston pump of claim 1 wherein the bypass valve includes a solenoid for opening and closing the bypass valve.
3. The high pressure piston pump of claim 2 wherein the bypass valve is normally open such that the at least one piston is normally deactivated.
4. The high pressure piston pump of claim 1 comprising three pistons wherein the bypass valve is fluidly connected to only one of the three pistons.
5. The high pressure piston pump of claim 4 wherein the piston to which the bypass valve is connected has a surface area that is larger than a surface area of each of the other two pistons.
6. The high pressure piston pump of claim 5 wherein a surface area of the piston to which the bypass valve is connected is approximately twice the surface area of each of the other two pistons.
7. The high pressure piston pump of claim 2 wherein the solenoid is activated by a signal from an engine electronic control unit.
8. The high pressure piston pump of claim 1 wherein the high pressure piston pump is a radial type piston pump.
9. The high pressure piston pump of claim 8 wherein the driveshaft includes a cam portion for driving the at least two pistons.
10. The high pressure piston pump of claim 1 wherein the high pressure piston pump is an

axial transfer piston pump and further comprising a swash plate connected to the drive shaft for driving the at least two pistons.

11. The high pressure piston pump of claim 10 further comprising a hydraulic oil side and a fuel side.

12. The high pressure piston pump of claim 11 wherein the at least two pistons are disposed in the hydraulic side.

13. The high pressure piston pump of claim 12 further comprising at least two diaphragms disposed in the fuel side wherein hydraulic oil displaced by the at least two pistons acts on the at least two diaphragms, respectively and the at least two diaphragms act on fuel disposed in the fuel side.

14. A high pressure radial type piston pump, comprising:  
a housing having a low pressure fuel inlet and a high pressure fuel outlet;  
three pistons disposed in the housing;  
a driveshaft for supplying power to drive the three pistons; and  
a bypass valve fluidly connected to one of the three pistons to deactivate the one piston.

15. The high pressure radial type piston pump of claim 14 wherein the bypass valve includes a solenoid for opening and closing the bypass valve.

16. The high pressure radial type piston pump of claim 15 wherein the bypass valve is normally open such that the one piston is normally deactivated.

17. The high pressure radial type piston pump of claim 14 wherein the one piston to which the bypass valve is connected has a surface area that is larger than a surface area of each of the other two pistons.

18. The high pressure radial type piston pump of claim 17 wherein a surface area of the one piston to which the bypass valve is connected is approximately twice the surface area of each of the other two pistons.

19. The high pressure radial type piston pump of claim 15 wherein the solenoid is activated by a signal from an engine electronic control unit.

20. The high pressure piston pump of claim 14 wherein the driveshaft includes a cam portion for driving the three pistons.

21. A high pressure axial transfer type piston pump, comprising:  
a housing having a low pressure fuel inlet and a high pressure fuel outlet;  
three pistons disposed in the housing;  
a driveshaft for supplying power to drive the three pistons; and  
a bypass valve fluidly connected to one of the three pistons to deactivate the one piston.

22. The high pressure axial transfer type piston pump of claim 21 wherein the bypass valve includes a solenoid for opening and closing the bypass valve.

23. The high pressure axial transfer type piston pump of claim 22 wherein the bypass valve is normally open such that the at least one piston is normally deactivated.

24. The high pressure axial transfer type piston pump of claim 21 wherein the piston to which the bypass valve is connected has a surface area that is larger than a surface area of each of the other two pistons.

25. The high pressure axial transfer type piston pump of claim 24 wherein a surface area of the piston to which the bypass valve is connected is approximately twice the surface area of each of the other two pistons.

26. The high pressure axial transfer type piston pump of claim 22 wherein the solenoid is activated by a signal from an engine electronic control unit.

27. The high pressure axial transfer type piston pump of claim 21 further comprising a swash plate connected to the drive shaft for driving the three pistons.

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28. The high pressure axial transfer type piston pump of claim 21 further comprising a hydraulic oil side and a fuel side.

29. The high pressure axial transfer type piston pump of claim 28 wherein the three pistons  
5 are disposed in the hydraulic side.

30. The high pressure axial transfer type piston pump of claim 29 further comprising three diaphragms disposed in the fuel side wherein hydraulic oil displaced by the three pistons acts on the three diaphragms, respectively and the three diaphragms act on fuel disposed in the  
10 fuel side.

31. A method of varying the flow output of a high pressure piston pump having at least two pistons comprising:

deactivating at least one of the at least two pistons.

32. The method of claim 31 wherein the at least one piston is deactivated by directing fluid displaced by the at least one piston to a bypass valve.

33. The method of claim 32 wherein the bypass valve is normally open.

34. The method of claim 32 wherein the bypass valve directs the fluid to a low pressure area of the pump.

35. The method of claim 32 wherein the fluid displaced by the at least one piston is fuel for  
25 an engine.

36. The method of claim 35 wherein the fluid displaced by the at least one piston is hydraulic  
oil.

37. The method of claim 33 further comprising closing the bypass valve to reactivate the at least one deactivated piston.

38. A high pressure fuel injection system, comprising:  
a source of fuel;

a low pressure pump;

a high pressure piston pump, the low pressure pump being disposed between the fuel source and the high pressure piston pump;

a fuel rail including a plurality of fuel injectors, the high pressure piston pump being disposed between the low pressure pump and the fuel rail; and

a fuel return line connecting the fuel rail to a low pressure side of the high pressure pump;

wherein the high pressure piston pump comprises a housing having a low pressure fuel inlet connected to an output of the low pressure pump, a high pressure fuel outlet connected to an input to the fuel rail, at least two pistons disposed in the housing, and a bypass valve fluidly connected to at least one of the at least two pistons to deactivate the at least one piston.

39. The high pressure fuel injection system of claim 38 further comprising a pressure sensor connected to the fuel rail.

40. The high pressure fuel injection system of claim 39 further comprising a pressure regulator connected to the fuel rail.

41. The high pressure fuel injection system of claim 38 wherein the high pressure piston pump is a radial type piston pump.

42. The high pressure fuel injection system of claim 38 wherein the high pressure piston pump is an axial type piston pump.